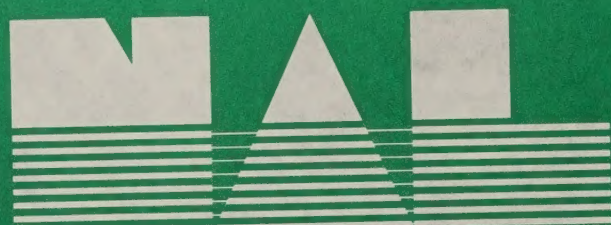


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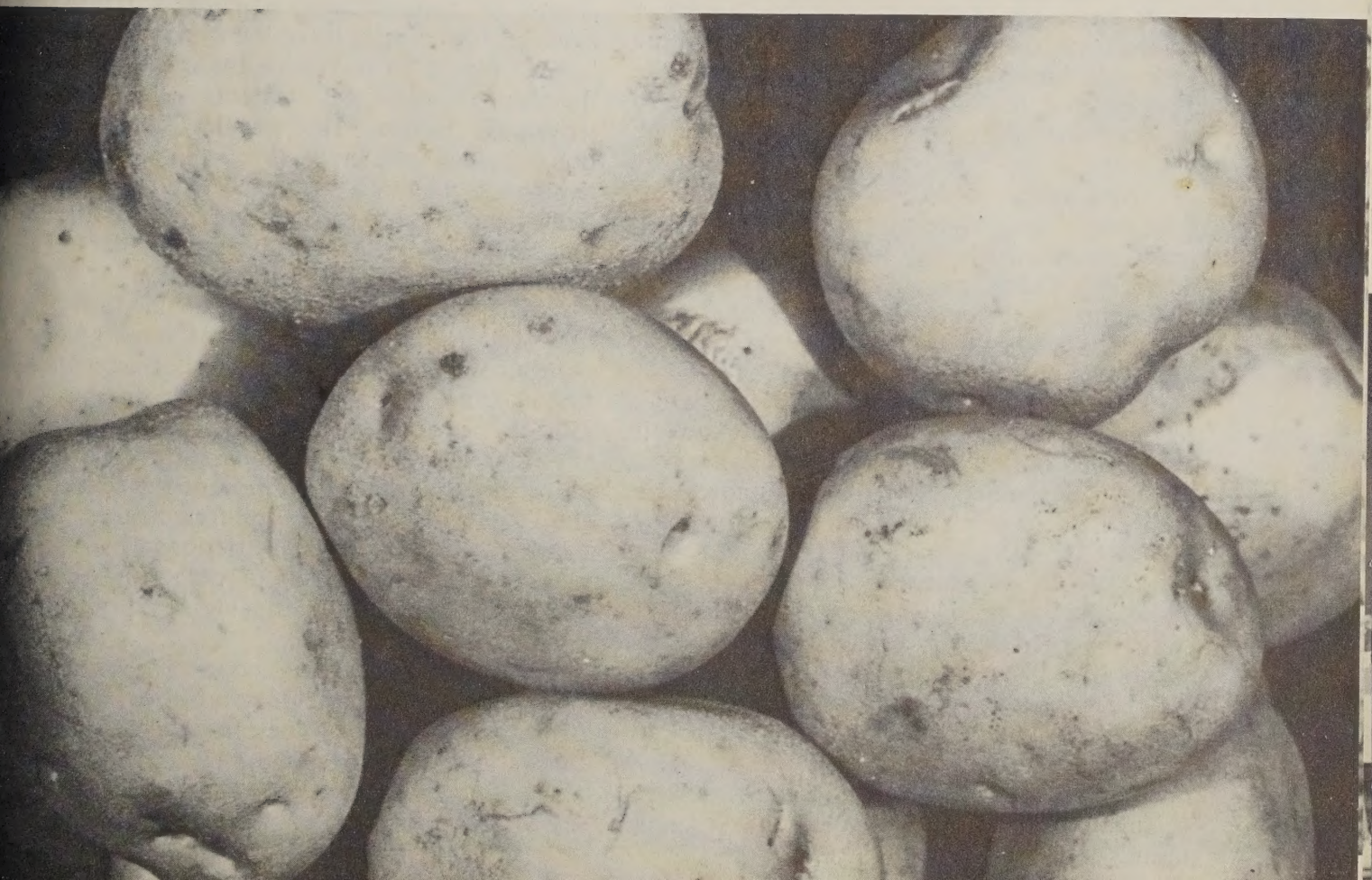
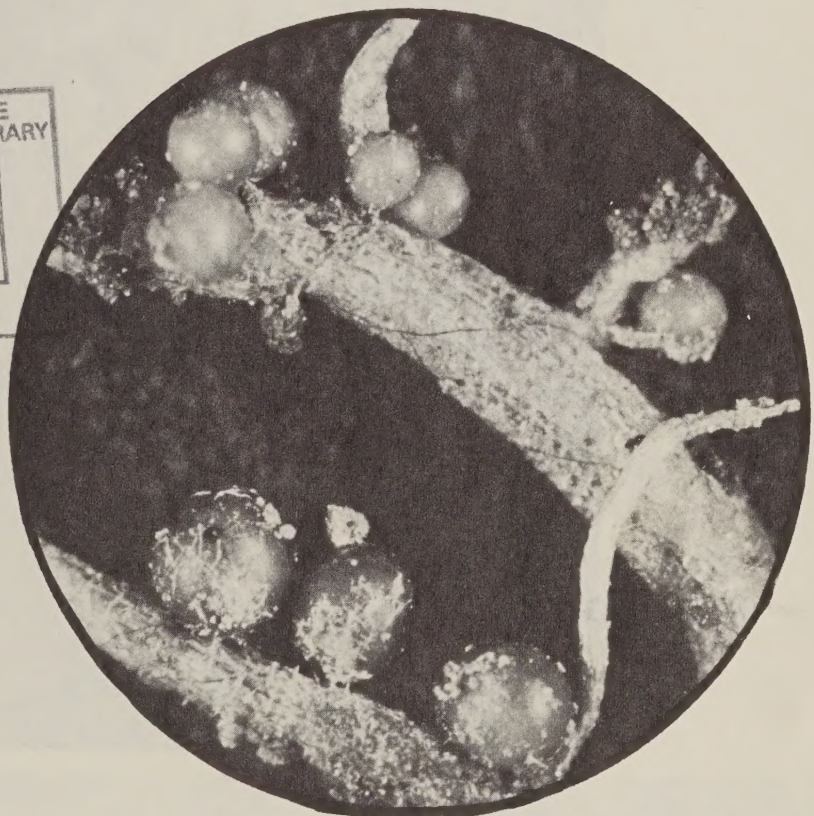
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THE GOLDEN NEMATODE:

Predator of the Potato





The golden nematode is undoubtedly the most serious pest threatening the American potato industry. It is recognized throughout the temperate regions of the world as one of the most difficult of all crop pests to control. It also attacks tomatoes, but is not a major threat to this crop.

Agricultural officials in countries where the nematode occurs agree that potatoes cannot be grown economically on land containing large numbers of the pest. Edible potato yields numbering less than the potatoes that were planted as seed have been reported from heavily infested areas.

For nearly 30 years, the golden nematode was known to occur in the United States only in Nassau and Suffolk counties, Long Island, N.Y. Then, in December, 1967, it was discovered in Steuben County, N.Y., and, in February, 1969, in New Castle, Delaware.

The golden nematode, *Heterodera rostochiensis*, passes through the egg, larval and adult stages in from 38 to 48 days. The eggs hatch within the dead, swollen bodies of fertilized females, which are called cysts. Cysts are flask shaped and much smaller than a pinhead. Each can contain up to 500 eggs. The cyst is a protective covering for the eggs and is resistant to some chemicals, drying, and some soil organisms.

In the spring, a substance given off by potato or tomato roots stimulates larvae to hatch from the eggs, leave the cyst, and migrate to host plants. In the roots, the nematodes rob the plant of water and nutrients and undergo a series of changes. The females become stationary, swell and break through the roots but remain attached by a thin neck. The males retain their slender eel-like form and mate with the females. After fertilization, several hundred eggs develop within the female and she dies.

The cyst is visible to the unaided eye. At first it is pearly white. Later, it turns golden, orange, and finally brown. Cysts become detached from the roots and remain in the soil after the crop has been harvested.

Since 1944, a State quarantine has been enforced in New York to prevent the spread of the golden nematode to uninfested areas. Marketing regulations and restrictions have been placed on the movement of potatoes, top soil and other commodities capable of carrying the nematode.

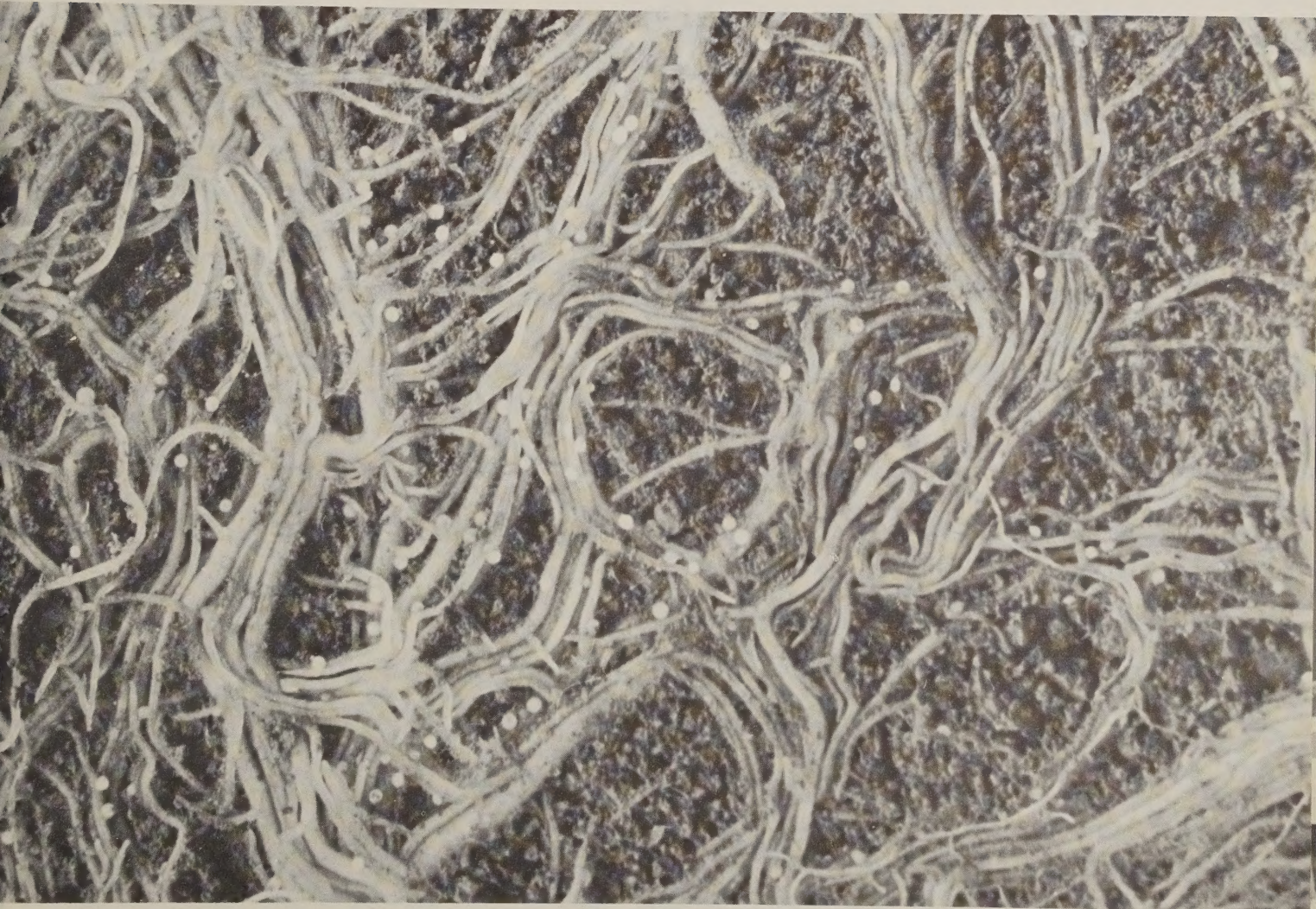
At the same time, cooperative Federal-State research and regulatory programs are being expanded to develop better ways to detect infestations of the pest and prevent its spread to other agricultural land. USDA's Agricultural Research Service is the cooperating Federal agency.



COVER INSET: Close-up of potato root hairs with immature females of the golden nematode. They get their characteristic golden color as they mature. The tough cyst wall can protect nematodes for many years under normal conditions. A chemical, given off by potato roots, stimulates the eggs, causing them to burst and allowing the released nematode larvae to invade and feed on root cells. (BN-32820; c-nem-clp-0-1).

Left: Normal (on the left) and infested potato plants at midseason. The main difference is in the size of the potatoes—heavily infested vines produce only an unmarketable crop of small potatoes because the parasitic nematodes have drained root cells of water and nutrients. (BN-32821; c-nem-root-1-1).

Below: Potato roots infested with golden nematodes. The round objects are swollen females bearing eggs and larvae. When the females die they fall off the roots and remain in the soil as cysts ready to infest the next potato crop. Each cyst contains up to 500 nematode eggs. (ST-3995-21; c-nem-clp-0-2).





BN-33235 (c) Soi-Sur-1-3

ST-4120-9 (c) Nem-Ss-0-16



The most reliable method for detecting the golden nematode is the collection of soil samples and the microscopic examination of the washed residue. Here, an ARS Plant Pest Control Division Scientist and survey crew leader map a potato field for survey (top left). A survey crew of USDA's Agricultural Research Service walks across a potato field picking up a trowel full of soil every 8 paces. The soil samples are put into marked paper bags that identify the field, and the location in the field from which the sample came (center left). After the bags of soil samples have been loaded into the survey vehicle, shoes and tools must be cleaned of dirt to make sure that the survey crew does not spread the golden nematode into noninfested fields (bottom left). At an Agricultural Research Service golden nematode laboratory—there is one at Hicksville and another at Bath, N.Y.—a soil sample is placed in a washing vat. Water is forced through the soil from the bottom to cause light material to float off into sieves. Fine screen in lower sieve sifts out cysts and other small objects. Technician washes this flotsam into beaker (below).

ST-4118-18 (c) Nem-Con-0-5



ST-3991-15 (c) Nem-Res-0-3



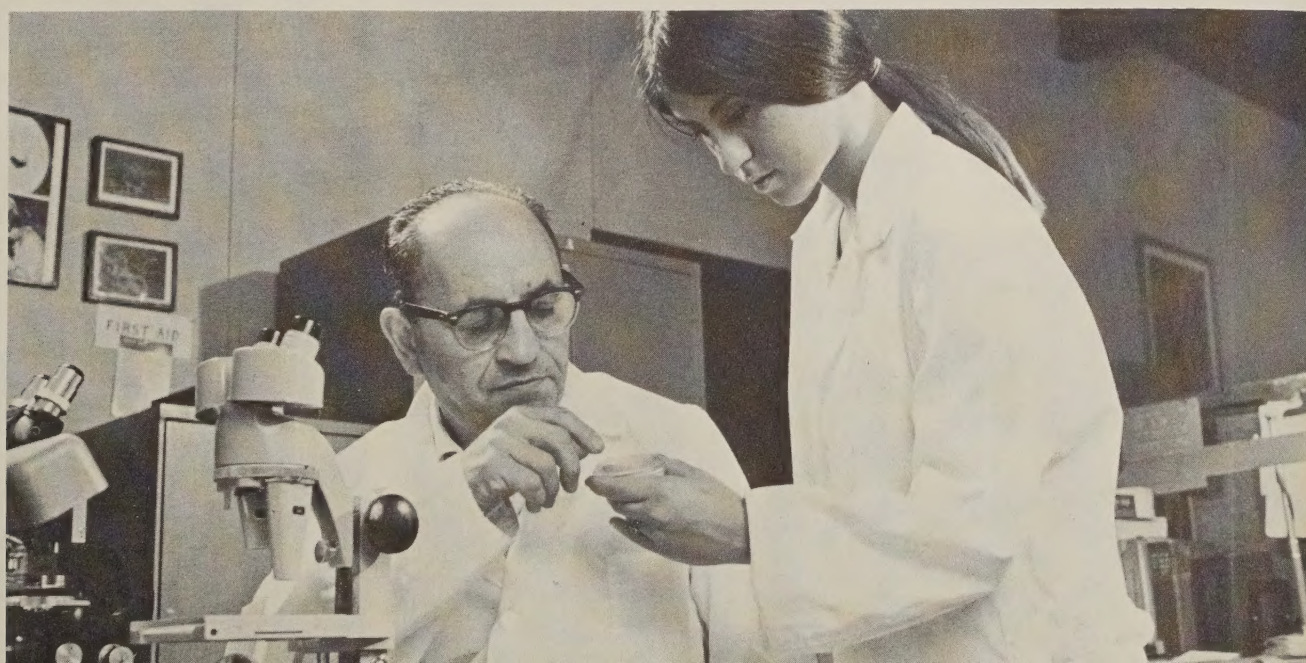


ST-4126-7 (c) Nem-Res-0-5



Flotsam is placed in 3-sectioned examining dish and viewed through low-power microscope. The examiner uses a probe to separate material and pick out suspect objects (left). When a suspect is found, the examiner takes the cyst-like material and places it in a glass dish marked with the same identifying numbers as those used on the original soil sample bag. The suspect material is then taken to an ARS Plant Pest Control nematologist who examines the cysts under low and then high power microscopes for positive identification. If golden nematodes are found, he dissects some of the cysts to see if the larvae in them are alive (below).

ST-3985-4 (c) Nem-Res-0-7



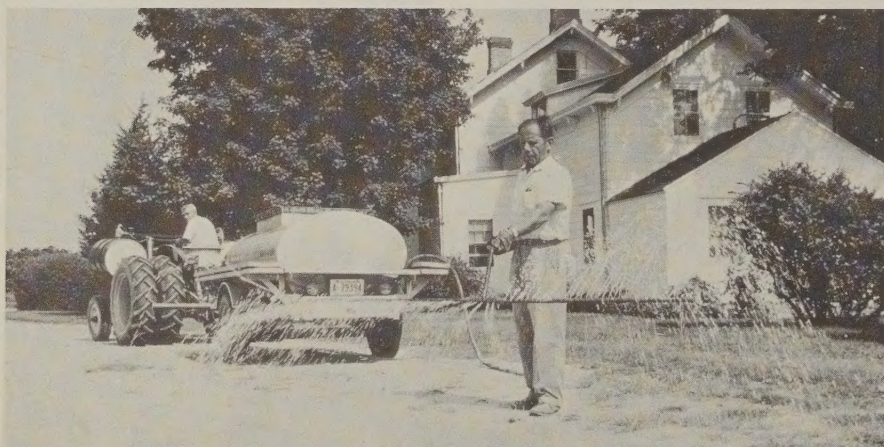


ST-3993-8 (c) Nem-Con-1-1

ST-3988-13 (c) Nem-Con-1-2



BN-33237 (c) Nem-Con-1-7



Control of golden nematode infestations starts with plowing and disking to put fields into seed-bed condition. Soil temperature and moisture content are measured to make sure conditions are right for soil fumigation. In this method, the fumigant is injected into the soil and then sealed under plastic sheets (top). Fields can also be treated by injecting fumigant about 8 inches underground and filling in furrows with a chain harrow. Dual wheels keep tractor from sinking into soft ground. Fields are re-treated about two weeks later to insure kill of nematode cysts (center left). On land where fumigant cannot be injected into soil, the area is drenched with a water solution of nematocide (bottom left).



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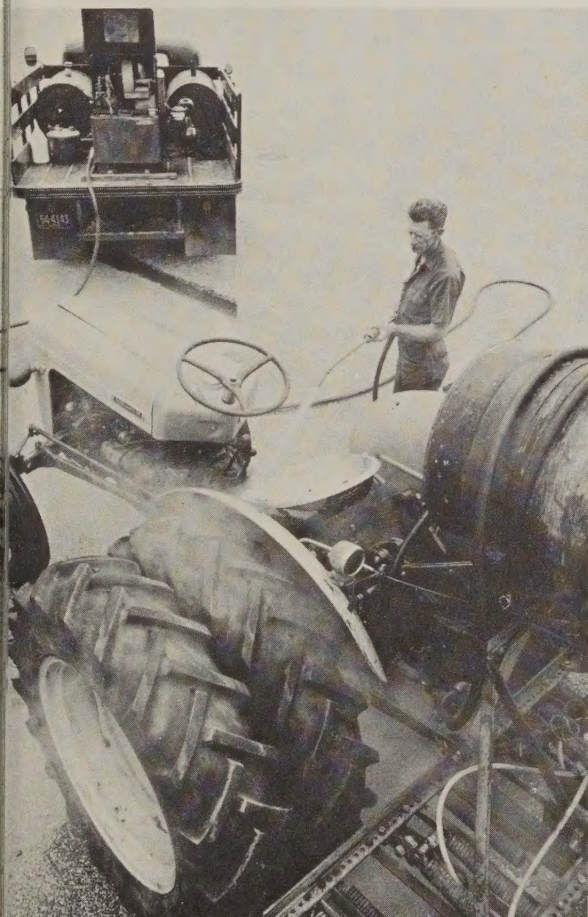
BN-33238 (c) Nem-Con-0-1

Regulatory phase of golden nematode control program includes supervision of topsoil moved from infested field being cleared for home construction. Regulations allow movement of soil, sod, or other materials only to nonagricultural areas (right). All equipment used on infested farms must be cleaned before being moved off the farm. In this case, steam is used to clean a tractor used for fumigating an infested field (below). Potatoes grown in the quarantined area are washed and sorted to remove undersized and injured tubers. These potatoes will be packed in new plastic or paper packs and sold on the consumer market. New burlap bags can be used only for potatoes going for export or ship stores. Dirt washed from these potatoes and cull tubers are deposited in approved sumps in nonagricultural areas (bottom right).

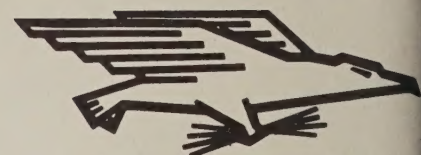
ST-4129-2 (c) Pot-Pro-0-32



N-33236 (c) Nem-Con-0-9



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Cornell University nematologist Dr. Martin Harrison checks one of these test plots at Farmingdale, N.Y. Research on golden nematode control includes plant breeding to develop potato

varieties resistant to the pest and the development of nematocides that destroy nematode cysts without injuring plants (BN-33233; c-nem-res-1-1).

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